NASA GSFC
Laser Safety Program

Health Physics Conference

May 2008 Cocoa Beach

Laser Safety Program Scope

- 251 Class 3b and Class 4 lasers
  - 24 used in navigable airspace (FAA)
  - 7 used in non-navigable airspace
- 152 Registered laser users
- 45 Certified laser labs/projects

Roles and Responsibilities

- Custodian:
  - AKA – Principle Investigator, Authorized User
  - Responsible for accountability
  - Responsible for safe use and storage
  - Responsible for all users in their lab or on their project
- User:
  - Must know and follow safety requirements
  - Must follow policies and procedures
  - Must use personal protective equipment when required
  - Must be familiar with the specific hazards of the laser used
  - Must immediately report unsafe conditions or operations to their custodian, Facilities Operations Manager or Laser Safety Officer

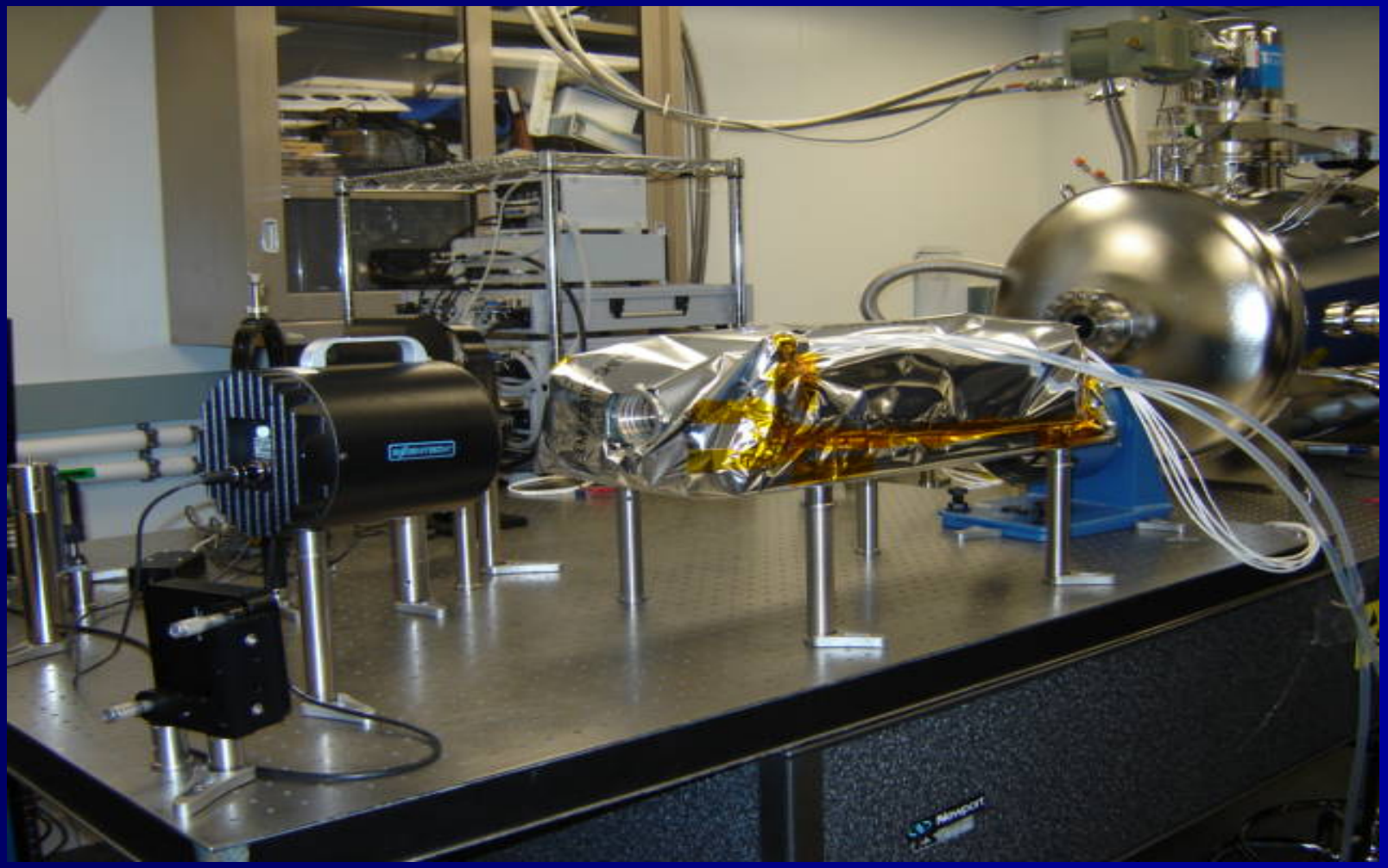
Roles and Responsibilities

- GSFC Laser Safety Officer
  - Inspect laser radiation use and storage areas
  - Audit and maintain inspection/evaluation records
  - Authorized to require cessation of operations when required
  - Provide consultation on Class 3b and Class 4 laser operations
- Management
  - Responsible for physical safety of personnel
  - Must assure that only approved personnel operate lasers
  - Must insure warning signs are procured and posted
  - Responsible for all Class 1, 2, 3a laser safety

Roles and Responsibilities

- GSFC Radiation Safety Committee (RSC)
  - Comprised of representatives from various directorates
  - Responsible to the Goddard Safety Council for overseeing development, direction and implementation of the GSFC Radiation Protection Program
  - Laser Safety Sub-Committee (LSSC) meetings held quarterly
  - Approve uses and users of Class 3b & Class 4 lasers
- Supervisors
  - Responsible for employees and projects
  - Must insure equipment is properly maintained
  - Must insure personnel are trained and knowledgeable

Laser Operations Approval Requirements



Laser Operations Approval Requirements

- Laser Radiation Source Approval
  - GSFC Form 23-6L (Class 3b & Class 4)
    - Approvals expire after three years
  - FAA Form 7140-1 for outdoor laser use in navigable air-space *(may include Class 1 laser)*
- Personnel Approval
  - GSFC Form 23-35LU (Class 3b & 4 only)
    - **Preplacement (Baseline) eye exam required**
    - **Approvals expire after three years**
    - **LSO will issue a certification card which must be kept by the laser user (OSHA Requirement)**
- User Certification
  - Users of Class 1, 2 & 3a lasers obtain certification from line management

Laser Operations Approval Requirements

- Laser Installation
  - GSFC Form 23-28L is completed by the laser custodian and submitted to the LSO with the GSFC Form 23-6L
  - A Form 23-28L is only prepared once
  - A Form 23-6L is usually completed for each project/program or lab using lasers

Training Requirements

Training Requirements

- Course A
  - Basic Understanding of Laser hazards
  - Understand warnings, hazards, & use instructions
  - Usually provided by management and/or the custodian
- Course B *(Includes Course A plus):*
  - Read GPR 1860.2A
  - Know user responsibilities & use approval procedures
  - Understand RSC imposed requirements
  - Understand consequences of violations
  - The remainder of this course is satisfied by completion of the course of laser safety instruction through the SATERN training web site.

Training Requirements

- Course C *(Includes Course B plus):*
  - Understand advanced laser math
  - Know beam characteristics & measurement
  - Know hazard zone determinations
  - Understand laser protective eyewear selection
- Outdoor Laser Operations *(Includes Course C plus):*
  - In-depth knowledge of laser safety including non-damaging visual effects, emission calculations, and engineering controls
  - Understanding operating procedures and safety requirements of the laser installation.
  - Able to complete FAA Form 7140-1

Training & Experience Requirements for Users

Table 3-1 Laser User Training and Experience Requirements			
Laser Class	**Course**	**Experience***	**Approval Authority**
1	-	None	Management
2	A	Hands-On Instruction	Management
3a	A	Hands-On Instruction	Management
3b	B	1 Week operational	RSC
4	B	1 Month operational	RSC

** Other requirements may be substituted for experience as determined appropriate by the RSC.*

Training and Experience Required for Custodians

Table 3-2 Laser Custodian Training and Experience Requirements			
Laser Class	Course	Experience*	Approval Authority
3b	C	1 Week	RSC
4	C	1 Month	RSC
Outdoor Laser Operations	C+**	6 Months	RSC

** Other requirements may be substituted for experience as determined appropriate by the RSC.*

*** Training requirements are specified in GPR 1860.2A, Section 3.d.*

Baseline and Termination Eye Examinations

- Recommended by ANSI Z136.1-2007
  - Ocular History
  - Visual Acuity Test
  - Macular Function Test
  - Color Vision Test

    (If results from above tests are abnormal, more in-depth evaluation may be required)

Inspection Requirements

- Line Management (Class 1, 2, & 3a)
  - Inspect for alterations
  - Personnel training up-to-date
  - Document inspection for LSO audit
- LSO (Class 3b & Class 4)
  - Reviewed prior to start-up
  - Reviewed after any alterations
  - Unannounced audits conducted

Outdoor Laser Operations

Outdoor Laser Operations

- ANSI Z136.6-2005
- Safety Hazard Analysis
- DoD Laser Clearing House Approval for certain systems directed toward outer space
- FAA letter of non-objection for lasers transmitting in navigable air space

  NOTE: "No laser system having a Letter of Objection from the FAA shall operate." (Ref: GPR 1860.2A)
- Evaluation of outdoor operations
  - responsibility of the user organization. *(The LSO will assist with technical guidance and review)*

Optical Fiber Communication Systems

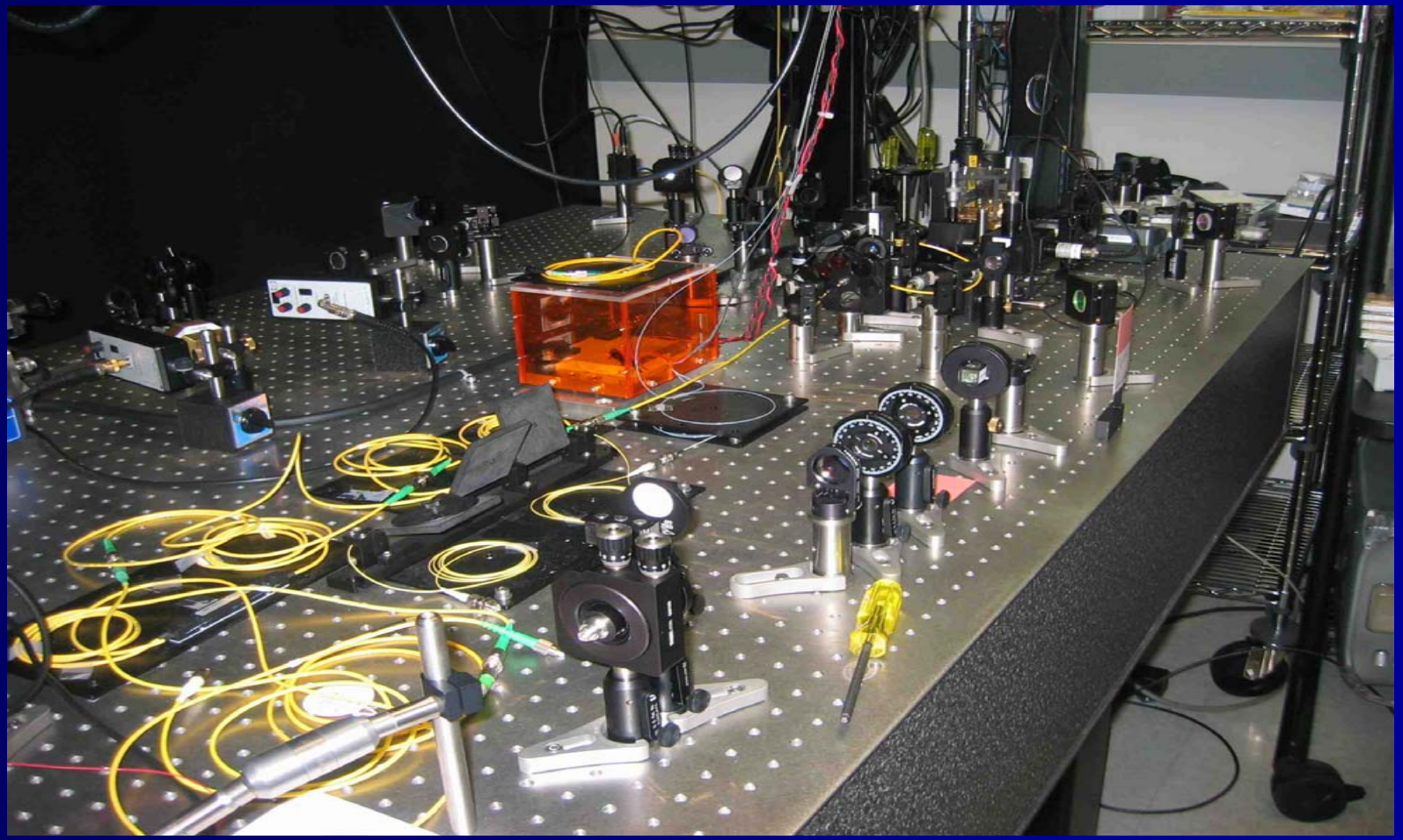
- Must follow guidelines established in ANSI Z136.2
- RSC approval must be obtained for these systems (GSFC Form 23-6L)

Off-Site Laser Operations

Off-Site Laser Operations

- Subject to requirements of the use site
- Appointment of a site laser safety officer for the project who has the authority to insure that safe operations are conducted and that local regulations are met.

Laser Radiation Protection Requirements



Laser Radiation Protection Requirements

- ANSI Z136.1-2007
  - Reference Table 10 for control measures
  - Alternate control measures may be approved only by the RSC with adequate justification
  - Protective eyewear should only be used after all engineering controls have been exhausted
  - Non-Beam Hazards
    - Electrical
    - Air contamination
    - Hazardous Waste
    - Confined spaces
    - Ergonomics
    - Plasma radiation
    - Fire/explosion
    - Compressed Gas
    - Laser dyes
    - Hazardous Noise

Caution Signs, Symbols, Labels and Posting

- Signs, symbols and labels must comply with ANSI Z136.1

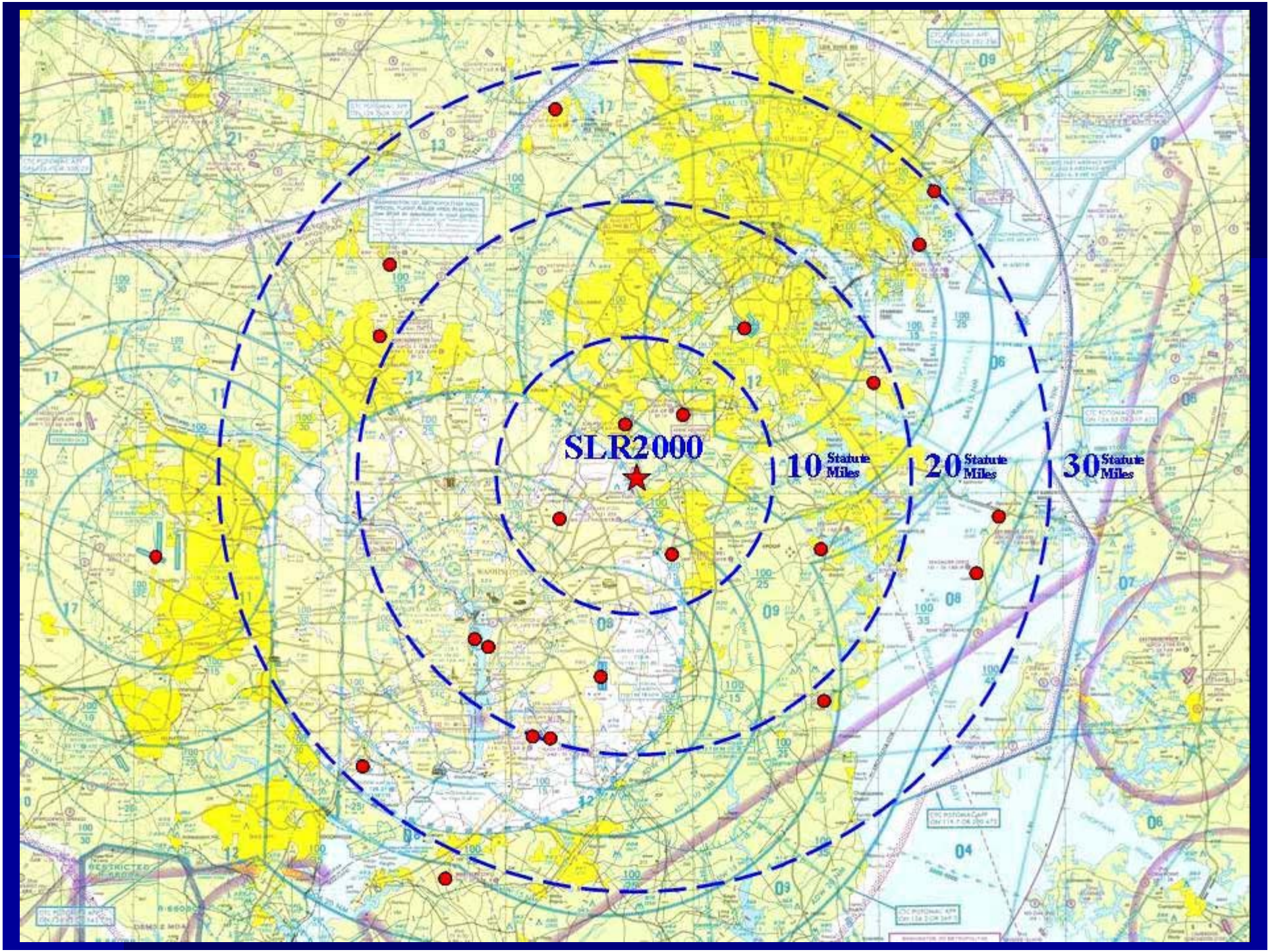
- User may provide on or near such signs any information that may be appropriate in aiding individuals to minimize exposure
- SOP must be posted on or near the laser control panel or at the entrance to the laser facility

NASA-GSFC Unique Location

Two laser sites

1. Greenbelt (Main Campus)
2. Goddard Geophysical and Astronomical Observatory (GGAO)

- Only a few miles apart
- Less than 12 miles from the White House


SLR2000
10 Statute Miles
20 Statute Miles
30 Statute Miles

Location challenges

- 24 airports within 35 mile radius

  including National, BWI and Dulles
- Need to identify Laser Free Zones, Critical Zones and Sensitive Zones around these airports relative to Goddard laser activities
- A lot of air traffic to consider for any outdoor laser operations

DoD coordination

- Department of Defense coordination required in addition to FAA
  - Any laser greater than 0.1 mW/cm2 at 60K feet.
- MLA earth uplink communication experiment needed to be coordinated with DoD. Restrictions impacted experiment.

GGAO Satellite Laser Ranging

- NASA MOBile LAser Ranging System's (MOBLAS 4,5,6,7,8) operating since early 1980's with no FAA issues
- MOBLAS 7 at Goddard GGAO site
- Next Generation Satellite Laser Ranging system (NGSLR)
  - NGSLR supports the Lunar Reconnaissance Orbiter
  - Currently seeking FAA Letter of Non-objection

MOBLAS 7 operating at GGAO

NGSLR located at GGAO

Laser Critical Zone

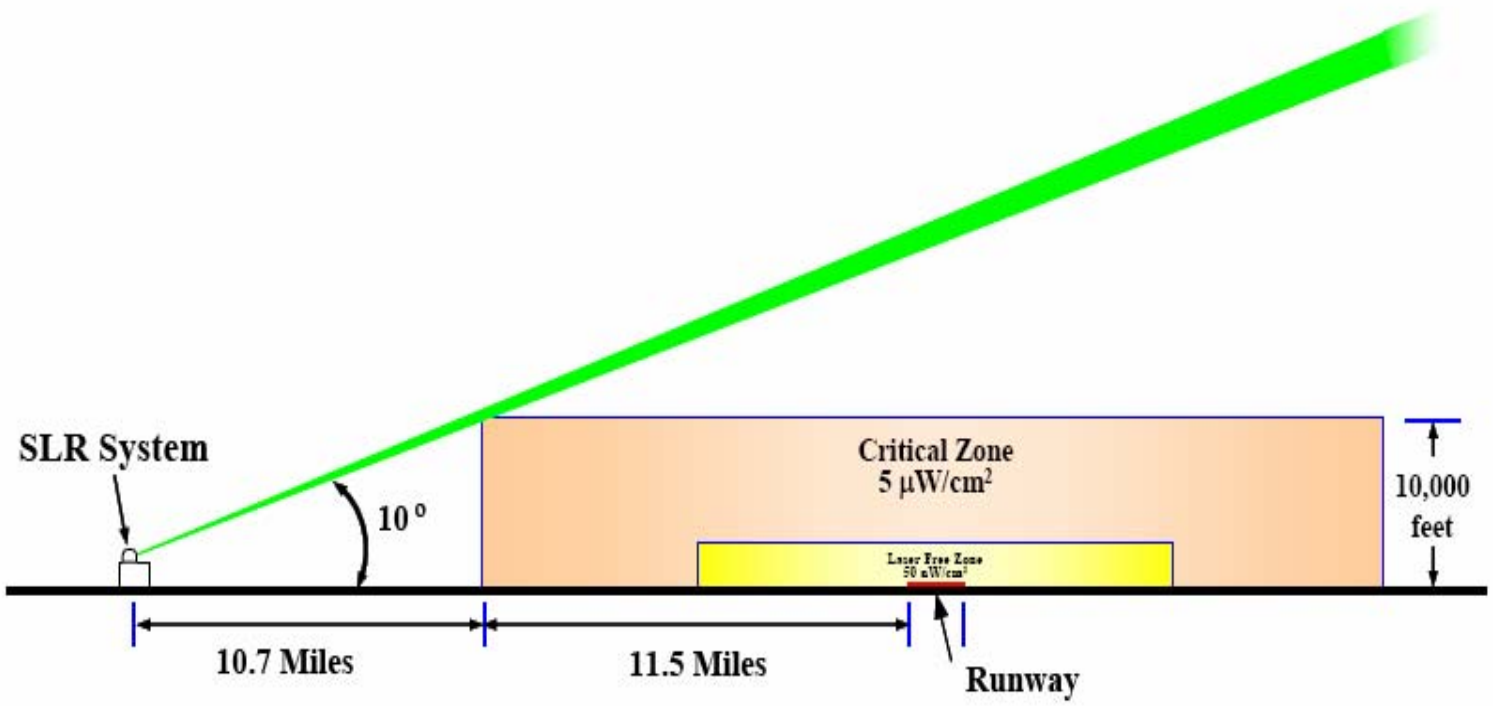


Figure 15 – Critical Zone Penetration Conditions

Laser Free Zone

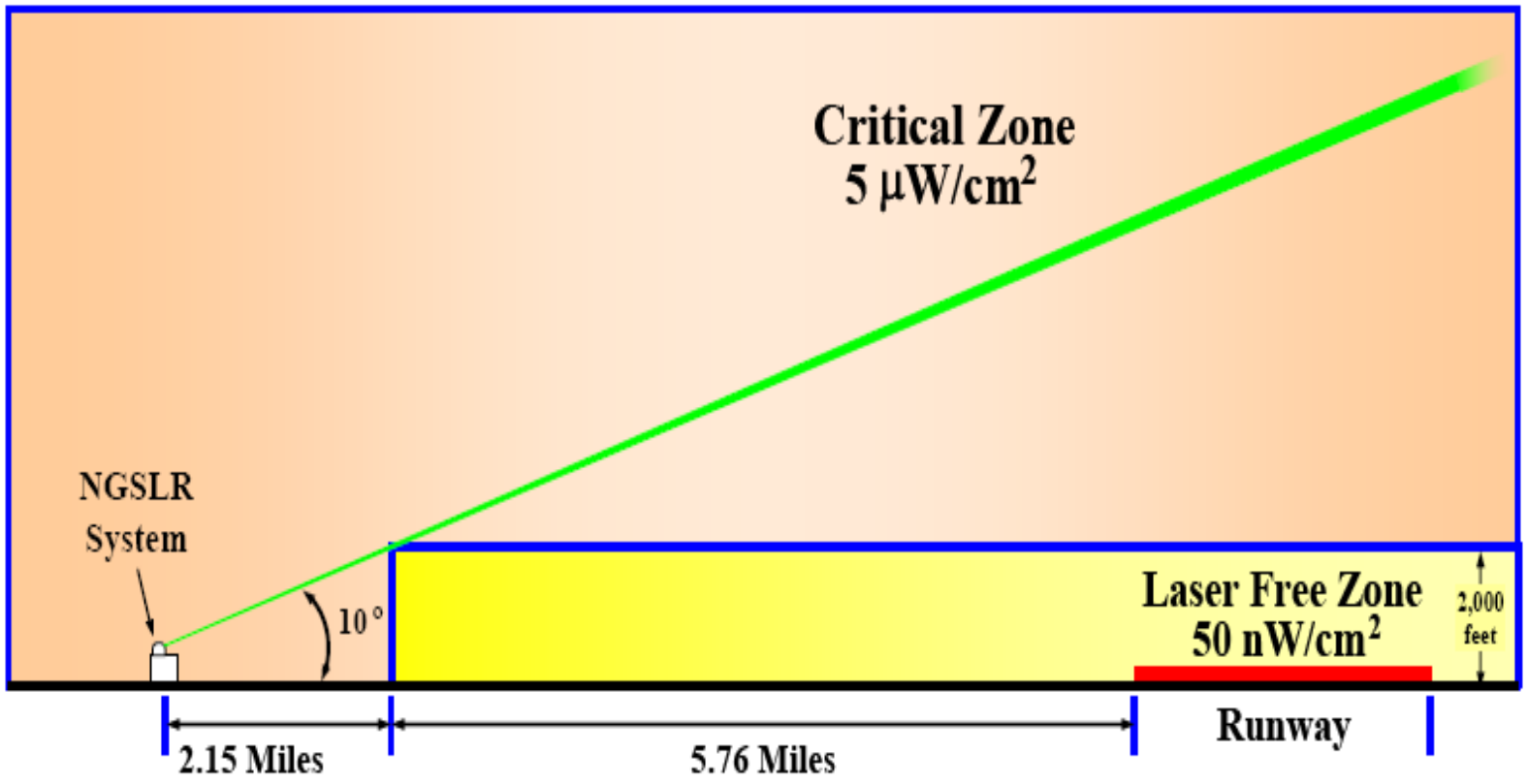


Figure 16 – Laser-Free Zone Penetration Conditions

GSFC off site laser use

Co2 Sounder Experiment deployed to Denver

Co2 Sounder Experiment laser inside van

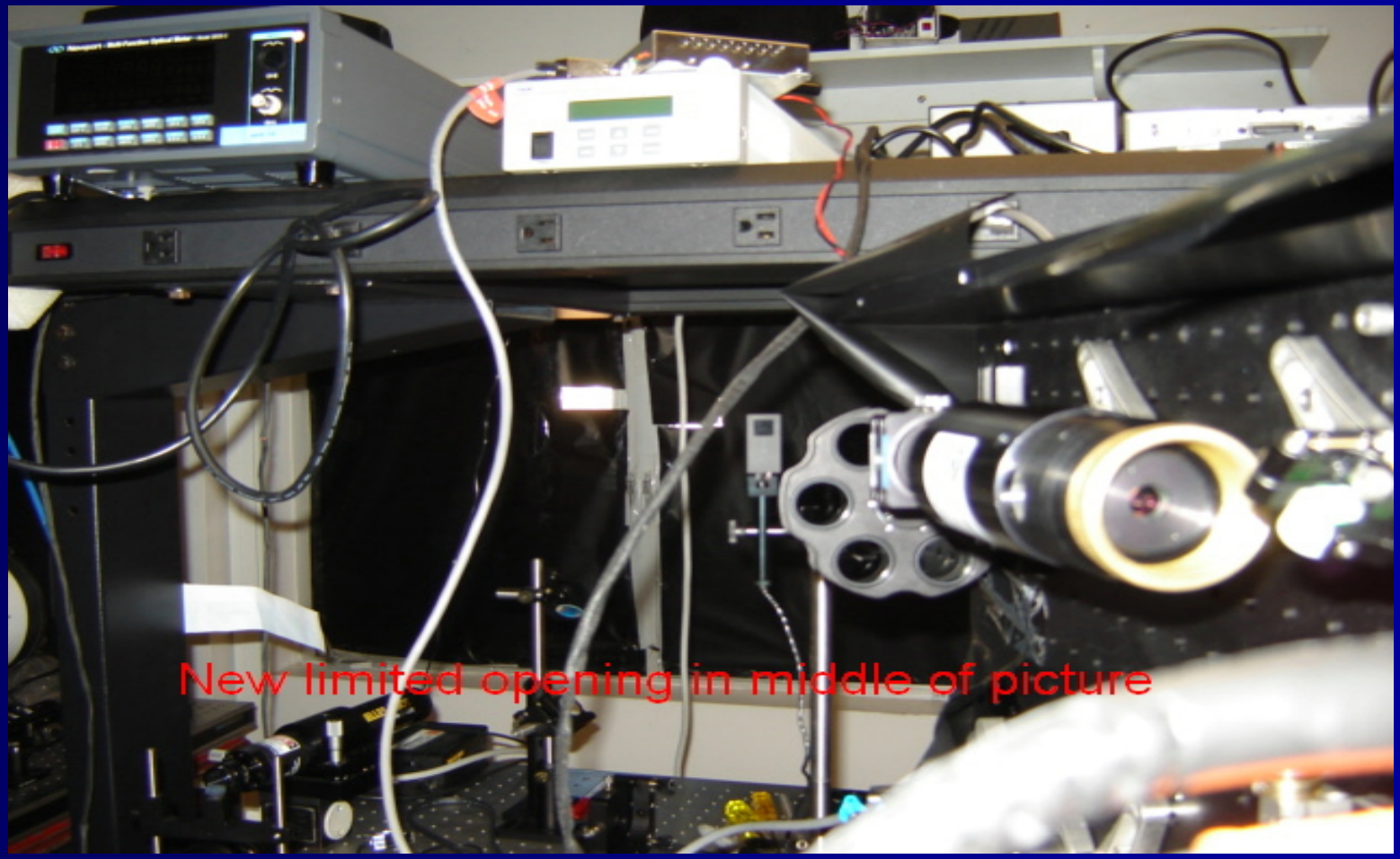
Perceived problems and resolution

- Education an important tool in a successful laser safety program

Perceived problems and resolution - example

- Experiment lasing over another NASA building to water tower
- Laser light seen on wall over office during meeting
- Creates concern for meeting attendees
- Laser Safety Office investigates
- Eye safe laser approved by Radiation Safety Committee
- Laser had “slipped” in fixture
- Made recommendations to eliminate possible future occurrences

Perceived problems and resolution – Pushbroom II



Questions/comments

GSFC Laser Safety Program

Ted Simmons
Laser Safety Officer
NASA-GSFC
8800 Greenbelt Road
Greenbelt, MD 20177
301-286-7367
theodore.d.simmons@nasa.gov